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Edition 3.2
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Indian Standard

SPECIFICATION FOR WOODEN PATTERN EQUIPMENT FOR FOUNDRIES

(Second Revision)

(Incorporating Amendment Nos. 1 & 2)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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Indian Standard
SPECIFICATION FOR WOODEN PATTERN EQUIPMENT FOR FOUNDRIES
(Second Revision)

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Indian Standard
SPECIFICATION FOR WOODEN PATTERN EQUIPMENT FOR FOUNDRIES
(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 14 November 1980, after the draft finalized by the Foundry Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This Indian Standard was first published in 1959 and was subsequently revised in 1971. While reviewing this standard, in the light of the experience gained during these years, the Committee has decided to bring it in line with the present practices being followed in the country in this field.

0.3 This edition 3.2 incorporates Amendment No. 1 (January 1983) and Amendment No. 2 (December 1983). Side bar indicates modification of the text as the result of incorporation of the amendments.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements for wooden patterns equipments. It specifies mould tapers, shrinkage allowances, methods of construction and other technical aspects of pattern making and usage. The system of colouring patterns is also covered by this standard.

1.2 This standard does not cover pattern accessories, like dowels, dowel sleeves, lifting pins and lifting and rapping plates, which are covered by separate Indian Standards (*see* IS : 6401-1970†, IS : 5988-1970‡, IS : 6376-1971§, and IS : 6378-1971||).

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*Rules for rounding off numerical values (*revised*).

†Specification for dowel pins for use in foundries.

‡Specification for spring dowel sleeves (light and heavy pattern) for use in foundries.

§Specification for pattern lifting pins and hooks for use in foundries.

||Specification for pattern lifting and rapping plates.

2. MATERIALS

2.1 Timber

2.1.1 *Softwood* — The softwood (coniferous timber) used for making patterns shall comply with IS : 190 - 1974*. Deodar Red cedar shall generally be used unless otherwise agreed to between the purchaser and the manufacturer.

2.1.2 *Hardwood* — The hardwood (non-coniferous timber) shall comply with IS : 1326-1976†. Teakwood shall generally, be used unless otherwise agreed to between the purchaser and the manufacturer.

2.1.3 *Moisture Content* — Moisture content shall not exceed 10 percent when measured by method prescribed in Appendix B of IS : 1141-1973‡.

2.1.4 *Stability* — For the purpose of this standard, stability shall mean that the dimensional change in individual pieces of timber shall not exceed 1 in 100 across the grain and 1 in 1 500 along the grain.

3. AUXILIARY MATERIAL

3.1 Cements — Animal glue (IS : 852 - 1969§) or synthetic resin adhesive (IS : 851 - 1978||).

3.2 Filling Material — For fillets under 3 mm radius and repairing patterns linseed oil, resin, epoxy based or nitrocellulose putties or espoxy resin and leather corners shall be used. For fillets above 3 mm, softwood hardwood and leather conforming to Type 2 or Type 3 of IS : 3840 - 1979¶ shall be used.

3.3 Wood Screw — Conforming to IS : 451 - 1972**.

4. RULES FOR DESIGNING

4.1 Shrinkage Allowance — Due to varying foundry techniques, the component design, shrinkage in castings may vary appreciably from that indicated by the normal shrinkage rules. Consequently, it is strongly recommended that the purchaser should consult the foundry about the shrinkage allowance, to be used in the construction of the

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*Specification for coniferous sawn timber baulks and scantling (*third revision*).

†Specification for non-coniferous sawn timber (baulks and scanlings) (*first revision*).

‡Code of practice for seasoning of timber (*first revision*).

§Specification for animal glue for general wood-working purposes (*first revision*).

||Specification for synthetic resin adhesives for construction work (non-structural) in wood (*first revision*).

¶Specification for lining leather (*first revision*).

**Technical supply conditions for wood screws (*second revision*).

pattern. For guidance, the following shrinkage allowance which are in common use for linear dimensions are given:

Cast Metal (1)	*Dimension* mm (2)	*Contraction* mm/m (3)	*Remarks* (4)
Grey cast iron	Up to 600	10	
	600 to 1 200	8	
	Over 1 200	7	
Cast steel	Up to 600	21	
	600 to 1 800	16	
	Over 1 800	13	
Aluminium	Up to 1 200	13	1.5 mm less for cored construction
	1200 to 1 800	12	
	Over 1 800	10	
Magnesium	Up to 1 200	15	
	Over 1 200	13	
Brass	—	15 to 16	
Bronze and gun metal	—	10 to 20	Varies with composition for sectional thicknesses between 6 and 12 mm. Lower values of contraction on for greater sectional thicknesses
Malleable iron and spheroidal graphite iron	—	9 to 12	

NOTE — The actual solid contraction taking place shall depend on several factors such as:

a) Composition of metal, impurities and constituents;

b) Method of moulding used, mould design, mould material and resistance offered by the mould to shrinkage;

c) Types of core used, core design, core material and resistance offered by cores to shrinkage; and

d) Design and intricacy of casting.

4.2 Machining Allowances — It is the extra material added to certain parts of the casting to allow their machining or finishing to proper size.

The value of machining allowance depends on:

a) method of moulding used,

b) size and shape of casting,

c) casting of orientation,

d) metal characteristics, and

e) functional requirements of casting and degree of accuracy and finished required.

4.2.1 Recommended machining allowance for ferrous metals (grey iron, steel and as cast S.G. iron castings only) shall be as specified in Table 1.

4.2.1.1 Machining allowance for other requirements shall be as follows:

a) Using dry sand moulding or machine moulding with wooden patterns, the machining allowance may be reduced by 20 to 25 percent from the values given in Table 1.

b) For malleable iron and heat-treated S.G. iron, machining allowance may be increased by 40 to 60 percent according to size.

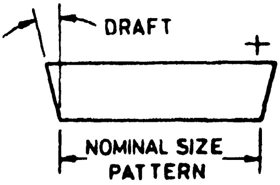
4.2.2 Recommended machining allowance for non-ferrous metals and alloys shall be as given in Table 2.

4.3 Clearances — Clearance between core and core seat on cope is provided to avoid damage of mould during core-setting and closing. This varies from 1 to 2 mm for small and heavy patterns respectively. For drag side also to ensure easy and snug fit a small clearance is provided but only on the sides and not at bottom (*see* Fig. 1). This varies from 0.25 to 0.5 mm.

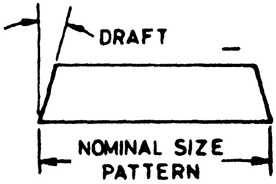
4.4 Mould Tapers (Draft) — Unless otherwise specified, the mould tapers specified in Tables 3 and 4 shall be adopted. Separate core prints, which are provided on the side of the pattern, have the core dimension at the lowest edge. For bigger patterns, the mould tapers shall be agreed upon between the purchaser and the manufacturer.

The mould taper may be specified in any one of the following ways and the purchaser shall indicate the method to be followed:

Mould taper add the draft +



Mould taper subtract the draft –



Mould taper average the draft ±

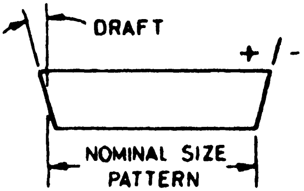


TABLE 1 MACHINING ALLOWANCE FOR HAND MOULDING USING WOODEN PATTERNS IN SAND CASTING

(*Clause* 4.2.1)

MAXIMUM OVERALL DIMENSION (mm)		MACHINING ALLOWANCE (mm) FOR DIMENSIONS											
		Over	—	100	200	300	500	800	1200	1800	2600	3800	5400
Over	Up to and Including	Up to and Including	100	200	300	500	800	1200	1800	2600	3800	5400	—
—	100		3.5										
100	200		4.0	5.0									
200	300		5.0	6.0	6.0								
300	500		5.0	6.0	6.5	7.0							
500	800		6.0	7.0	7.0	8.0	9.0						
800	1 200		7.0	7.0	8.0	8.0	9.0	10.0					
1 200	1 800		7.0	8.0	8.0	9.0	10.0	10.0	11.0				
1 800	2 600		8.0	8.0	9.0	9.0	10.0	11.0	11.0	12.0			
2 600	3 800		9.0	9.0	9.0	10.0	11.0	11.0	12.0	12.0	13.0		
3 800	5 400		10.0	10.0	11.0	11.0	12.0	12.0	13.0	14.0	15.0	16.0	
5 400	—		10.0	11.0	11.0	12.0	12.0	13.0	14.0	15.0	16.0	18.0	20.0

NOTE 1 — Actual machining allowance shall be equal to machining allowance as per above table plus pattern draft on sides or bores.

NOTE 2 — Machining allowances on bores, cut-outs curved or round surfaces shall be increased by 20 percent.

NOTE 3 — For castings where length is over 6 times the height or width, extra allowance shall be given to take care of warpage.

NOTE 4 — On dimensions of top surfaces, machining allowance may be increased by 20 percent.

NOTE 5 — Above machining allowance values are for guidance only. For complex castings, these shall be decided mutually between the foundry and planning section.

TABLE 2 MACHINING ALLOWANCE FOR HAND MOULDING USING WOODEN PATTERNS IN SAND CASTING

(*Clause* 4.2.2)

(For copper base alloys and light metal alloy castings)

Maximum Overall Dimensions (mm)		Machining Allowance (mm) for Dimensions						
Over	Up to and Including	Over	—	100	200	300	500	800
		Up to and Including	100	200	300	500	800	1200
—	100		2.0					
100	200		2.5	2.5				
200	300		3.0	3.0	3.0			
300	500		3.5	3.5	3.5	4.0		
500	800		4.0	4.0	4.5	5.0	5.0	
800	1 200		4.5	5.0	5.5	6.0	6.5	7.0

NOTE 1 — All the notes given under Table 1 shall apply for copper base and light metal alloy castings also.

NOTE 2 — Using metal patterns and machine moulding or shell moulding, the value of machining allowance may be reduced by 20 percent.

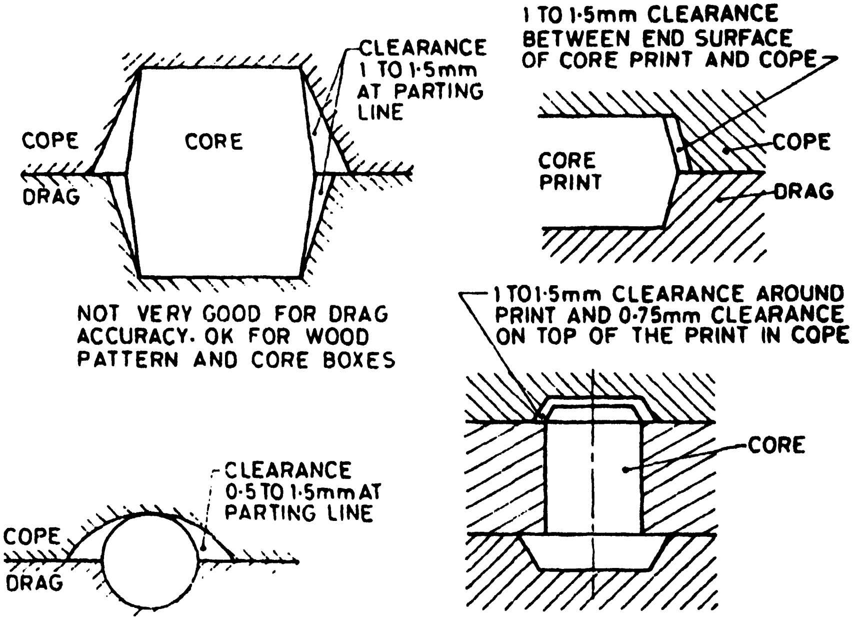

CLEARANCE 1 TO 1·5mm AT PARTING LINE
COPE
CORE
DRAG
NOT VERY GOOD FOR DRAG ACCURACY. OK FOR WOOD PATTERN AND CORE BOXES
1 TO 1·5mm CLEARANCE BETWEEN END SURFACE OF CORE PRINT AND COPE
CORE PRINT
COPE
DRAG
1 TO 1·5mm CLEARANCE AROUND PRINT AND 0·75mm CLEARANCE ON TOP OF THE PRINT IN COPE
CORE
CLEARANCE 0·5 TO 1·5mm AT PARTING LINE
COPE
DRAG

FIG. 1 CLEARANCE FOR CORE AND CORE SEAT ON COPE

TABLE 3 MOULD TAPERS FOR EXTERIOR SURFACES OF PATTERNS

(*Clause* 4.4)

HEIGHT mm	TAPER mm	HEIGHT mm	TAPER mm
Up to 10	0.5	Over 150 up to 250	2.0
Over 10 up to 20	0.75	Over 250 up to 400	3.0
Over 20 up to 35	1.0	Over 400 up to 600	4.0
Over 35 up to 65	1.0	Over 600 up to 800	5.0
Over 65 up to 150	1.5	Over 800 up to 1 000	6.0

NOTE — Mould tapers for internal surfaces of patterns shall be double of those given above for external surfaces.

TABLE 4 MOULD TAPERS FOR VERTICAL CORE PRINTS

(*Clause* 4.4)

	HEIGHT UP TO 70 mm		HEIGHT ABOVE 70 mm	
Print location	Top	Bottom	Top	Bottom
Taper, mm	6	1.5	8	2.0

4.5 Sand Cordon — A sand cardon is a ledge provided at the end of the lower side of the core print. Its purpose is to take up the sand flowing out during the insertion of the core, in order to ensure a satisfactory core seat. The dimensions are specified in Table 5 and they shall be used according to the size of the core print.

TABLE 5 DIMENSIONS OF SAND CORDON

WIDTH mm	HEIGHT mm
5	3
10	6
15	10
25	15

4.6 Edge Roundings — The edges of all the surfaces with machining allowance shall be rounded, the radius of rounding being not more than 65 percent of the machining allowances, exceptions are large surfaces, which lie in the plane of the mould joint.

4.7 Crush Strip — Crush strip is a small continuous projection made at the periphery of pattern as in Fig. 2.

Crush strip is provided to protect the edge of the moulds while closing and thereby preventing sand falling into the mould cavity. Width and thickness of crush strip depends upon the pattern size. Usually 10 × 1 mm strip will be sufficient. Wherever crush strips are not provided a minimum fillet radius of 1 to 1.5 mm is to be provided at the corners between pattern and match plate. The material for this is to be as per **3.2**.

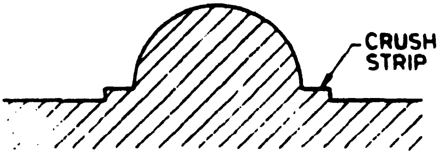


FIG. 2 CRUSH STRIP

4.8 Jolt Strip or Wear Strip — Jolt strip or wear strip is provided on match plate to have perfect sealing of mould while closing. Usually 30 × 3 mm M.S. strips are fixed on match plates. Wear strip surface should be flat and 0.4 to 1 mm above match plate surface. The surface of the moulding box edge which is seating on the wear strip also should be smooth and variation on flatness should be less than half of that of the gap between wear strip and match plate.

5. CLASSIFICATION

5.1 Wooden Patterns

5.1.1 *Grade A (Hardwood Equipment in the Steel Reinforcement)* — It comprises wooden patterns and core boxes for large runs in hand or machine moulding, where the requirements for precision and condition are high. They shall be metal reinforced at high wear surfaces by provision of steel strips not less than 3 mm thick. The patterns shall be made of hardwood requirements of which shall comply with those specified in **2.1.2** to **2.1.4**. Further, for rigidity of frame suitable metal or wooden supports may be used.

5.1.1.1 For joining together the segments to discs, rings, frames, and similar parts of equal thickness, the joints provided shall be tongue and groove. The surfaces to be glued together shall be given a sharp (teeth form) finish so that they fit each other. Other wood joints shall have a key and slot, dovetail, etc, depending on the thickness of the wood and the load on the joint.

5.1.1.2 The filling material for fillets shall be used in accordance with the requirements given in **3.2**.

5.1.1.3 Lifting eyes, straps for bolts, dowels and rapping plates, shall be used where applicable (*see* Fig. 3, 4 and 5). The internal structure and reinforcement, including guide boxes, shall be of sufficient strength to support eyes or bolts as given in Fig. 3.

5.1.1.4 The patterns shall be given a triple coating of lacquer*. However, for core boxes, only one external coating shall be sufficient. For segmental construction, the end strips shall be so fixed that the lifting of patterns is along the grains so as to minimize wear and ensure good mould finish (*see* Fig. 6).

5.1.2 *Grade B (Hardwood Patterns)* — For use where substantial quantities of castings are required either intermittently in small lots or in initial large runs. General requirements construction wood used and dimensional stability shall be same as those for 'Grade A' but no metal reinforcement at high wear surfaces is provided.

5.1.3 *Grade C (Softwood Patterns Reinforced with Hardwood)* — These shall be used for occasional indefinite use. The construction methods of **5.1.1** shall be applied only where high precision is required and in construction of core boxes. General construction will be done with seasoned softwood (coniferous timber) of heavy thicknesses. The wearing surfaces shall be reinforcous with seasoned hardwood using only countersunk wood screw and glue putty fillets may be used up to 10 mm radius.

5.1.4 *Grade D (Skeleton Patterns)* — These need only be suitable for the moulding of one or very few castings. The material may be the lowest grades of softwood or hardwood. Stability requirements are not applicable unless specified by the purchaser. Fillets may be drawn in putty up to 18 mm radius. Any methods may be used for joinery.

5.1.4.1 It is recommended that skeleton patterns should not be reused after 'one-off' without an immediate recheck.

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*Some varieties of air-hardening oil sands are likely to react with lacquers, a trial before using the lacquer will be useful.

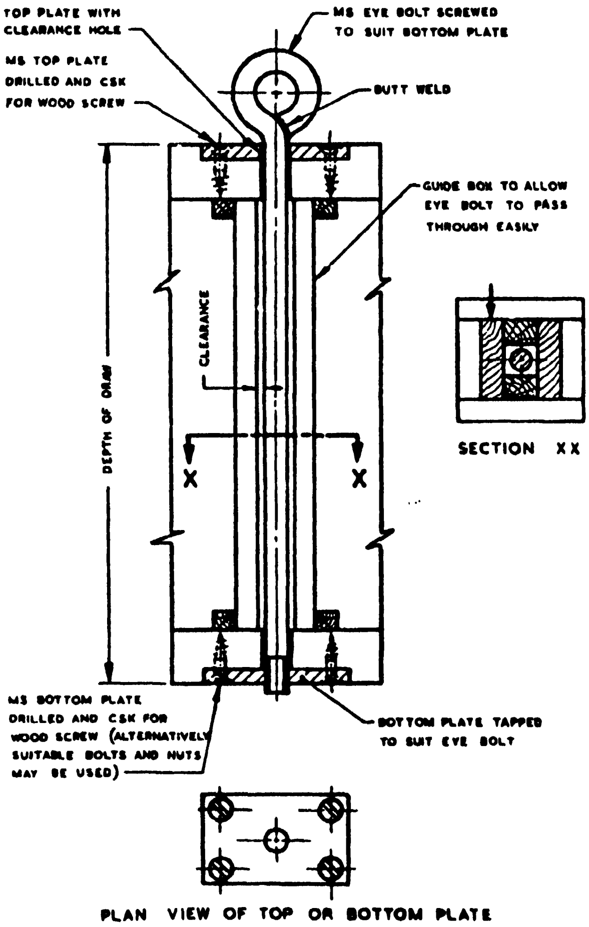
TOP PLATE WITH CLEARANCE HOLE
MS TOP PLATE DRILLED AND CSK FOR WOOD SCREW
MS EYE BOLT SCREWED TO SUIT BOTTOM PLATE
BUTT WELD
GUIDE BOX TO ALLOW EYE BOLT TO PASS THROUGH EASILY
CLEARANCE
DEPTH OF DRAW
X
X
SECTION XX
MS BOTTOM PLATE DRILLED AND CSK FOR WOOD SCREW (ALTERNATIVELY SUITABLE BOLTS AND NUTS MAY BE USED)
BOTTOM PLATE TAPPED TO SUIT EYE BOLT
PLAN VIEW OF TOP OR BOTTOM PLATE

FIG. 3 TYPICAL LIFTING EYE AND PLATES

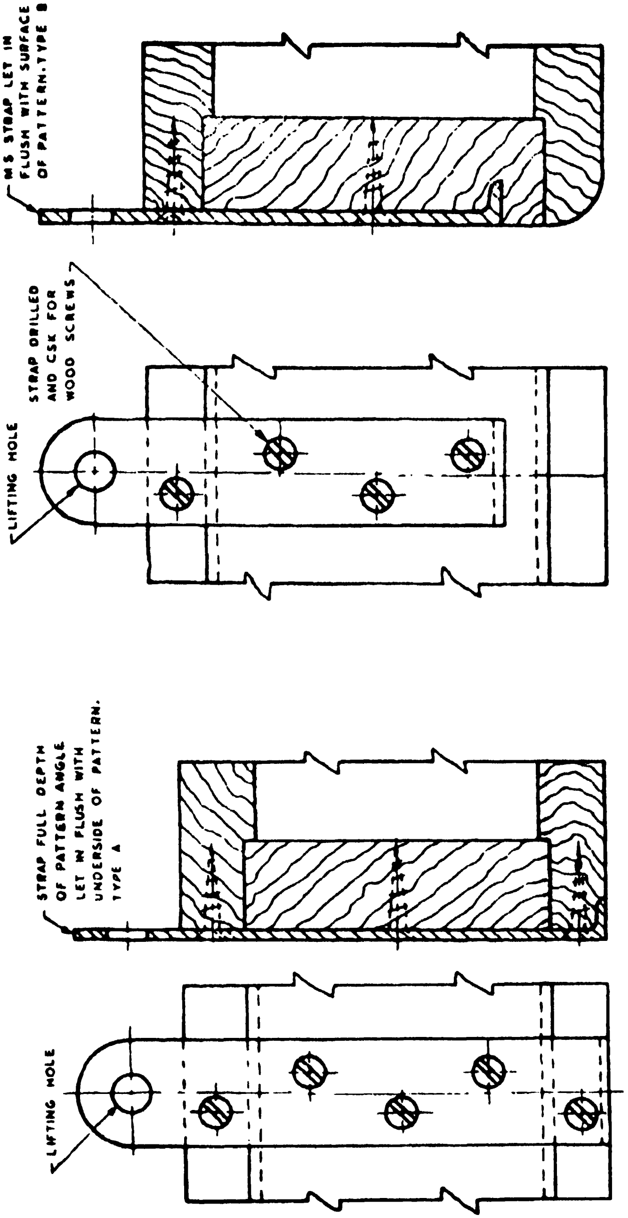
M S STRAP LET IN FLUSH WITH SURFACE OF PATTERN. TYPE B
STRAP DRILLED AND CSK FOR WOOD SCREWS
LIFTING HOLE
STRAP FULL DEPTH OF PATTERN ANGLE LET IN FLUSH WITH UNDERSIDE OF PATTERN. TYPE A
LIFTING HOLE

FIG. 4 TYPICAL LIFTING STRAPS

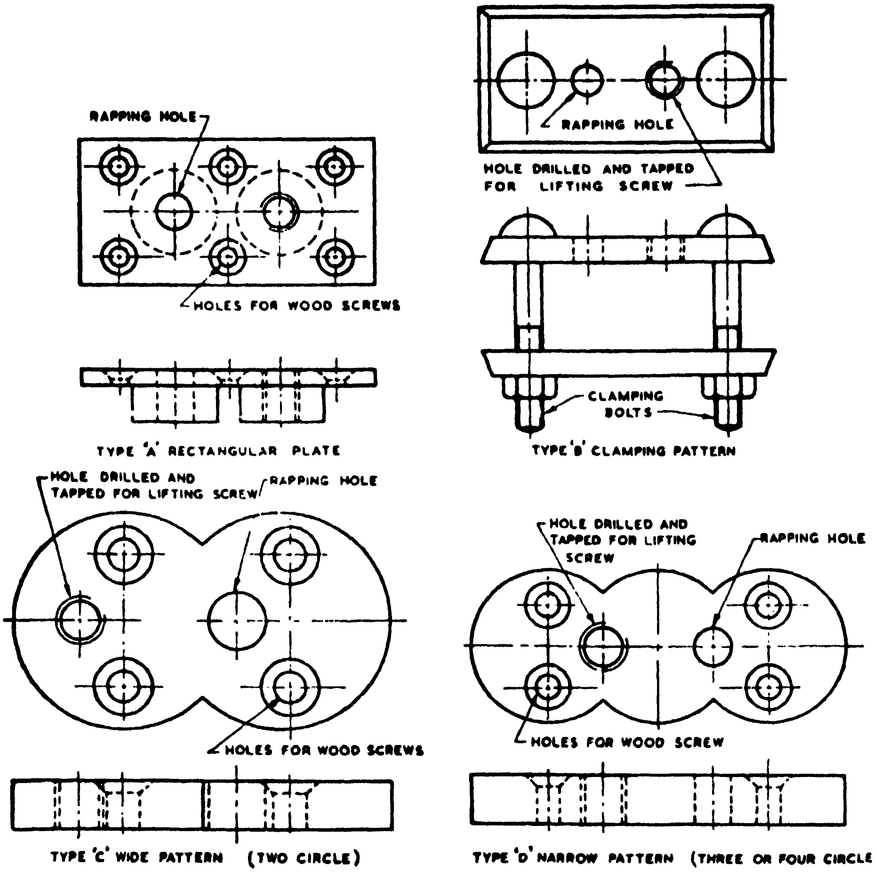
RAPPING HOLE
HOLES FOR WOOD SCREWS
TYPE 'A' RECTANGULAR PLATE
RAPPING HOLE
HOLE DRILLED AND TAPPED FOR LIFTING SCREW
CLAMPING BOLTS
TYPE 'B' CLAMPING PATTERN
HOLE DRILLED AND TAPPED FOR LIFTING SCREW
RAPPING HOLE
HOLES FOR WOOD SCREWS
TYPE 'C' WIDE PATTERN (TWO CIRCLE)
HOLE DRILLED AND TAPPED FOR LIFTING SCREW
RAPPING HOLE
HOLES FOR WOOD SCREW
TYPE 'D' NARROW PATTERN (THREE OR FOUR CIRCLE

FIG. 5 TYPICAL COMBINED LIFTING AND RAPPING PLATES

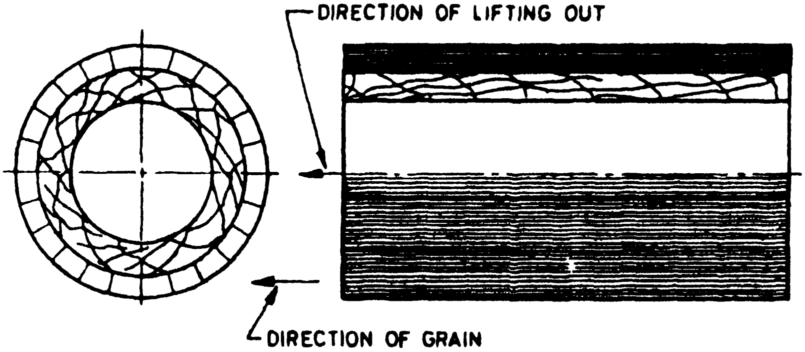

FIG. 6 METHOD OF LIFTING PATTERNS

Fig. 7 deleted

5.2 Metal Sprayed Patterns

5.2.1 When metal patterns are uneconomical and the wooden patterns inadequate, Grades A and B of wooden patterns may be aluminium spray coated. The coating shall be 0.075 to 0.1 mm thick and shall be continuous on all important surfaces.

6. PERMISSIBLE VARIATIONS (TOLERANCES) ON PATTERN AND CORE-BOX DIMENSIONS

6.1 Permissible variations (tolerances) on pattern and core-box dimensions shall be as specified in Table 6.

TABLE 6 PERMISSIBLE VARIATIONS (TOLERANCES) ON PATTERN AND CORE BOX DIMENSIONS

(*Clause* 6)

NOMINAL SIZE mm	WOODEN PATTERNS	
	Grades A & B	Grades C & D
Up to & including 50	0.5	0.8
Over 50 „ 150	0.6	1.0
„ 150 „ 300	0.8	1.2
„ 300 „ 500	1.0	1.5
„ 500 „ 800	1.2	2.0
„ 800 „ 1 200	1.5	2.5
„ 1 200 „ 1 800	1.8	3.0
„ 1 800 „ 2 500	2.1	3.5
„ 2 500 „ 4 000	2.4	4.0
„ 4 000	2.7	4.5

NOTE — The values given in the table show the width of tolerance zone and are positioned symmetrically about the basic size.

7. STANDARD COLOUR SYSTEM

7.1 Unless specifically agreed to the contrary, the colour system specified in Table 7 and Fig. 8 shall apply. The colours shall conform to the following shades of IS : 5 - 1978*:

Blue	No. 166
Orange	No. 557
Black	—
Red	No. 537
Green	No. 218
Brown	No. 411
Grey	No. 631
Yellow	No. 309

Note — For Ref No. regarding colouring and marking, *see* Table 7.

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*Specification for colours for ready mixed paints and enamels (*third revision*)

TABLE 7 COLOURING SYSTEM FOR FOUNDRY PATTERN

(*Clause* 7.1)

REF NO. (*see* FIG. 8)	SURFACE	COLOUR/MARK
(1)	(2)	(3)
1)	Surfaces to be left as cast (unmachined)	Blue (Steel) Red (Grey cast iron) Grey (Malleable cast iron) Orange (Heavy metal castings) Brown (Light metal castings)
2)	Surfaces to be machined	Yellow
3)	Core prints for unmachined openings and end prints:	
	Periphery	Black
	Ends	Black
4)	Core prints for machined openings:	
	'A' Periphery	Yellow strips or black
	'B' Ends	Black
5)	Pattern joints (split pattern):	
	'A' Cored section	Black
	'B' Metal section	Clear varnish
6)	Touch core:	
	'A' Core shape	Black
	'B' Legend	'Touch'
7)	Seats of and for loose core prints	Green
8)	Stop-offs	Diagonal black strips or clear varnish
9)	Chilled surfaces: 'A' Outlined in legend	Black 'Chill'
*10)	Fillets	Black broken line

NOTE — The colour scheme given against Ref No. (2) to (10) is applicable to all types of castings including steel, cast iron (grey and malleable), heavy metal (including copper alloys, nickel alloys, lead alloys, zinc alloys, etc), and light metal (including aluminium, aluminium alloys and magnesium alloys).

*Not shown in the Fig. 8.

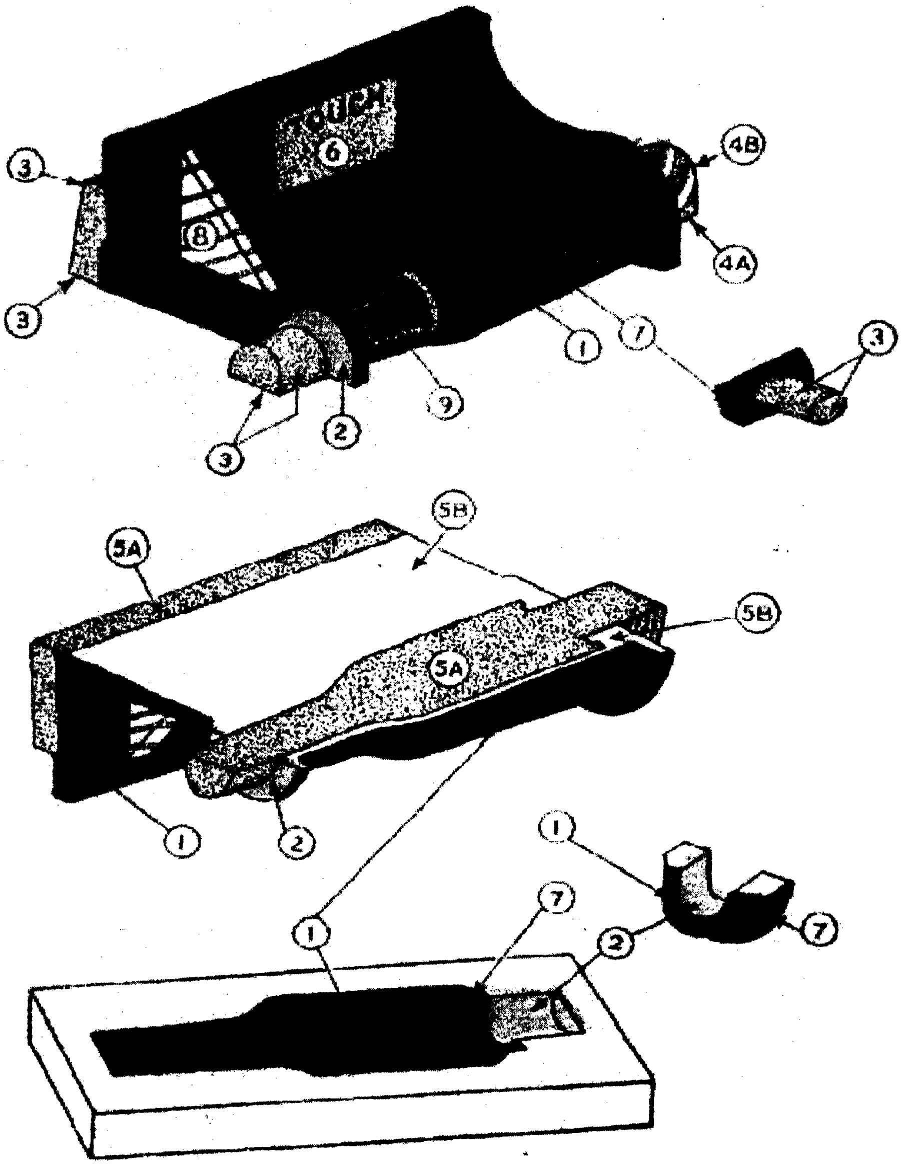

FIG. 8 COLOURING AND MARKING SYSTEM FOR WOODEN PATTERN EQUIPMENT FOR GREY IRON CASTINGS

8. MARKING

8.1 On every pattern and loose piece belonging to the pattern and on every core box, the pattern code number/works order number shall be marked. In addition, the main pattern unit shall be marked with the following information:

a) Number of cores;
b) Number of stop-offs and loose pieces;
c) Pattern quality grade; and
d) Where space permits, drawing number to which the pattern is made.

8.2 In the case of patterns with many core boxes the various companion core boxes and prints shall be numbered if required by the purchaser in the sequence in which the cores are placed in the mould. On sweeps and strickle boards, and limiting distance for setting the jig shall be marked.

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